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ON THE CLASSIFICATION OF THE SENSATIONS OF SMELL.

(Critical.)

BY W. S. FRANKLIN, STATE UNIVERSITY, LAWRENCE.

The theory of the specific energy of the nerves is, that to each quality of sensation there are specific corresponding elements of the nervous system. The end organs of these elements are so grouped and conditioned for each of the special senses as to be exposed with advantage to a particular class of external stimuli. However, any specific nerve group leads to the corresponding sensation when disturbed by any physical means whatever. We think, then, of quality of sensation as due to the particular nerve-cells that are excited, and not to the quality of the excitement; indeed, all nervous activity seems to be alike in kind.

Not only are the nerve elements of each of the five special senses specifically distinct, but also some of the single senses comprehend a number of distinct groups of specific nerve elements, each leading to a sensation more or less distinct. Thus the sense of touch includes at least two separate senses, viz.: the sense of pressure or of touch proper, and the sense of heat, each depending upon specific corresponding nerve elements. There is also some reason for believing that the sensation of cold corresponds to the excitement of a group of nerves distinct from those leading to the sensation of heat.

The sense of sight depends upon three specific groups of nerves. Their action, however, is at variance with the above statement of the law of the specific energy of the nerves, for a combined excitement of the three produces a single sensation of color instead of three distinct, simultaneous, corresponding sensations; indeed, that color sensations are triply manifold, is due to the fact that quality of color depends upon the mixed excitement of these three specific groups. That this fact does not weaken the theory of the specific energy of the nerves, is evident when we consider that *any sensation of particular significance tends to assume a specific character as perceived by consciousness*; indeed, any sensation, even if brought about by the combined action of separate specific nerve elements, is perceived as a unit if it has enjoyed a significance as a whole during our entire experience as a species, and if there has been no occasion for the analysis of it by the higher centers (which in fact may be impossible). This manner of attainment of a specific quality by a sensation must depend upon the nervous organization in the higher centers, together with a specific cross-connection with the cells of the subordinate centers upon which depend the more general qualities of the sensation in question.

To whatever extent the theory of the specific energy of the nerves be true, it is justifiable to assume that the quality of the sensations of smell depends upon the action of specific nerves. The question remains whether the number and quality of the sensations of smell depend upon the variable and mixed excitement of a few specific nerve groups as in the case of color sensations, or whether there may be a large number of specific nerve groups corresponding to as many characteristic odors, and also whether the sensations of smell form a continuous manifoldness, and are capable of systematic arrangement as are colors, or whether they are more or less discrete and do not admit of such an arrangement.

It seems that this question may be answered by considering the nature of the external stimuli active in the sense of smell, as follows:

Let us assume that the number and quality of smell sensations are dependent upon the mixed action of but few specific groups, so that so far as the *apparatus* of smell is concerned, it is possible for the sensations of smell to form a continuous manifoldness of few dimensions; but the external stimuli of smell are discrete, and

some of the mixed excitations of these assumed nerves of smell must be outside of our experience, and consequently the corresponding sensations do not exist, and they would probably be found wanting even if by any artificial means the mixed excitement in question could be produced. Considering the discreteness of the chemical properties of compounds, it seems questionable whether a number of specific end organs could, by each responding more or less to the action of different compounds, give mixed excitements characteristic of these compounds.

Hence it seems that the sensations of smell must form a discrete manifoldness in any case, and it seems also that there must be a large number of specific groups of olfactory nerves, each corresponding to a characteristic odor forming an element of the above manifoldness, though probably each characteristic odor may be the nucleus of a limited region of continuity.

The existence of a large number of specific nerve groups is not without example among the several senses. For the auditory apparatus comprehends as many as sixteen to twenty thousand specific elements, each with an end organ adapted to the disturbing influence of a particular case of external stimulus. However, in any case the arrangement of a large number of specific end organs so as to prevent confusion is a difficult problem (remembering that the strongest argument in a case like the present is to show the possibility). Histology, indeed, recognizes but one type of end organ in the *regio olfactoria*, but we must remember that the character of the external stimuli active in the sense of smell requires the distinctive feature of these end organs to depend upon molecular structure, so that the microscope cannot distinguish between them. On the other hand, the character of the external stimuli of sound requires form to be the distinctive feature of the specific end organs of hearing. The present usefulness of the sense of smell to man scarcely seems to warrant the existence of a highly-organized apparatus of smell, yet there can be no doubt but that there may have been a period in our development when this sense was vastly more important. Indeed, there are indications of the degeneration of this sense in man.

All the experimental results in this field, although perfectly powerless in the direction in which the investigators have attempted to apply them, viz., toward the establishment of a systematic arrangement of odors, are cumulative evidence of the discontinuous nature of the sensations of smell, and of the existence of a large number of independent (nearly) groups of specific olfactory nerves.

Then, too, the fact that contrast effects are not known in odors as they are in colors, and the fact that fatigue for one odor leaves the sense delicate for another, both partake of the nature of positive evidence in this direction. If the large amount of patient and careful research in this field had been applied as evidence of this view of the subject, it might not have been so entirely fruitless, although it is difficult to see how positive evidence in this direction is to be reached, at least until histology is able to attack molecular structure, and chemistry has cleared away the mist still hanging over the nature of the "odorous particles."

NOTES ON MAGNETIC DECLINATION IN KANSAS.

BY PROF. F. O. MARVIN, STATE UNIVERSITY, LAWRENCE.

By Kansas law, each county surveyor in the State is required to observe the declination of the magnetic needle four times in each year—in the months of January, April, July, and October—and to report the results to the office of the Secretary of State and to the Chancellor of the University. No compensation is fixed for the